LRFD

Section 3.56

New: January 2005

3.56.1 <u>General</u>

1.1 Material Properties

Concrete
Standard compressive strength for P/S Double-Tee Girder
shall be: f'_{ci} = 4.5 ksi
                                                               f'_c = 6.0 ksi

Optional concrete strength shall be: f'_{ci} = 5.0 ksi
                                                               f'_c = 7.0 ksi

LRFD 5.4.2.4   Modulus of Elasticity, $E_c = 33000K_1 w_c^{1.5} \sqrt{f'_c}$

For $f'_c \leq 5$ ksi, w_c = 0.145 kcf
For $f'_c > 5$ ksi, w_c = 0.140 + 0.001f'_c

K_1 = correction factor for source of aggregate
 = 1.0 unless determined by physical testing

Prestressing strand

LRFD 5.4.4.1   Type of strand:
AASHTO M203 (ASTM A416) Grade 270
Uncoated, seven-wire, low-relaxation strand

LRFD Table 5.4.4.1-1   Ultimate tensile strength, f_{pu} = 270 ksi

LRFD Table 5.4.4.1-1   Yield strength, f_{py} = 0.9f_{pu} ksi

LRFD 5.4.4.2   Strand modulus of elasticity, E_p = 28500 ksi

For standard concrete:
 Strand diameter, d_{ps} = 0.5"
 Strand area, A_{ps} = 0.153 in^2
For optional concrete:
 Strand diameter, d_{ps} = 0.6"
 Strand area, A_{ps} = 0.215 in^2

Mild reinforcing steel

LRFD 5.4.3.1   Minimum yield strength, f_y = 60.0 ksi

LRFD 5.4.3.2   Steel modulus of elasticity, E_s = 29000 ksi

1.2   GIRDER AND SLAB DESIGN

The cast-in-place slab is designed to carry only the live load of the bridge. One layer of steel is used in each direction of the cast-in-place slab with 1" clearance from bottom of slab. A 1" integral wearing surface is deducted from effective slab depth for design.

The double tee girder flange is designed to carry the load of the cast-in-place slab, the flange weight and a 50 lb./sq. ft. construction dead load. (or a 300 lb. concentrated construction load per OSHA).

When determining the section properties of the double tee girder the center of gravity is based upon the total area (excluding corner fillets) of the entire exterior or interior girder and not on the individual stems. Moment of inertia and dead loads to each stem are figured to the center of the flange between the stems. The non-composite dead load of the external double tee girder is divided according to the following sketch.

Dead Load to Ext. Stem —————→|←——————— Dead Load to Int. Stem

ℂ Ext. Stem ————→|←— 2'-0" —|— 2'-0" —→|←———— ℂ Int. Stem
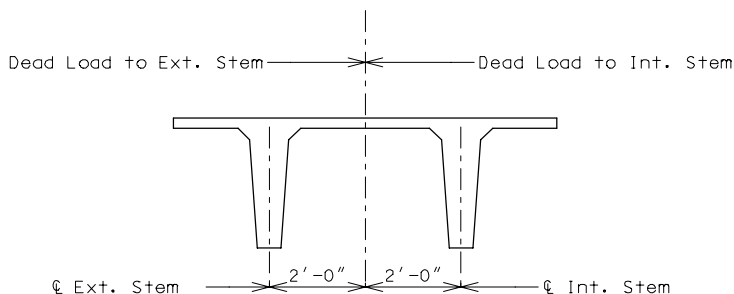
The non-composite dead load of the interior double tee girder is divided evenly to each stem. A 9 lb./lin ft. dead load is added to the non-composite dead load of each stem for haunching. The non-composite dead load of C.I.P. slab, girder and haunch are based on simple spans from ℂ to ℂ Bearings.

The composite dead load of the safety barrier is divided 75% to the exterior stem of the exterior girder and 25% to the interior stem of the exterior girder. No dead load due to the barrier curb is added to the interior girder. The composite dead load for future wearing surface is 35 lb./sq. ft. or 3" of material. The composite dead load of safety barrier curb, and future wearing surface are based on continuous, composite spans from ℂ to ℂ Bearings.

The live load design is based on HL93. The live load distribution factors are figured separate for exterior and interior Double Tee Girders. The assumption, that if the bridge is widened in the future the exterior girder then becomes an interior girder should be investigated.

Composite sections are adjusted for the difference in modulus of elasticity of slab and girder by multiplying by the factor (Eslab/Egirder). A 1″ integral wearing surface is deducted for effective slab design.

Negative moment reinforcement is based on the amount required for the entire roadway width and not the amount required for each stem. The continuous span lengths are based on the distance from the ℄ Bearing at End Bents to the ℄ Interior Bent. The area of reinforcing bars is provided by adding bars between the normal longitudinal bars.
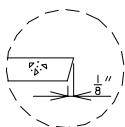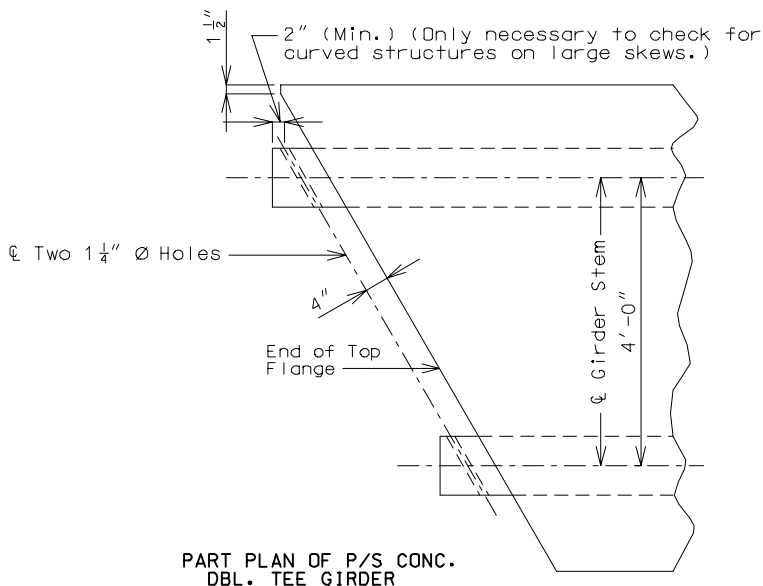
Continuity is obtained at intermediate supports by extending and bending all strands to form interlocking right angle hooks and pouring a concrete diaphragm monolithic with deck slab encasing the prestressed girders with the flange cut back at diaphragm.

Camber is based on simple spans. A transformed moment of inertia is figured for the total exterior or interior double tee girder since the total girder is cambered at the same rate.
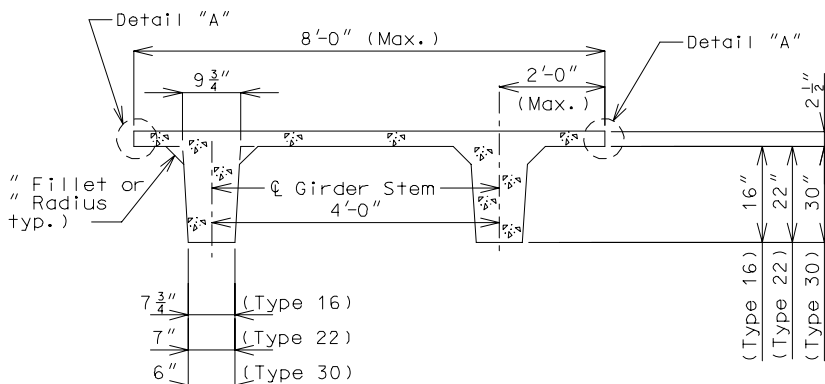
Maximum horizontal curvature for Double-Tee structures is 3°. Outside flange edge of exterior girders on curved bridges is to be curved.
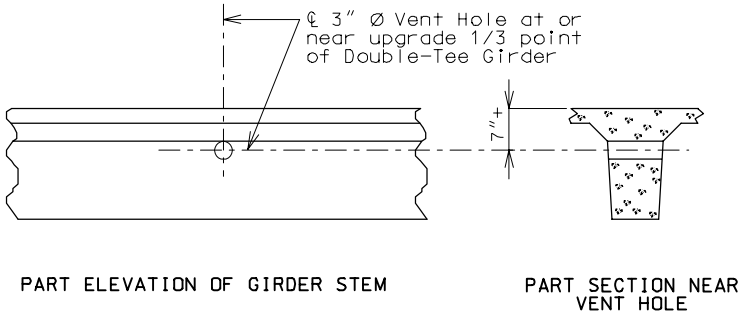
3.56.2 Details

2.1 Girder Dimensions
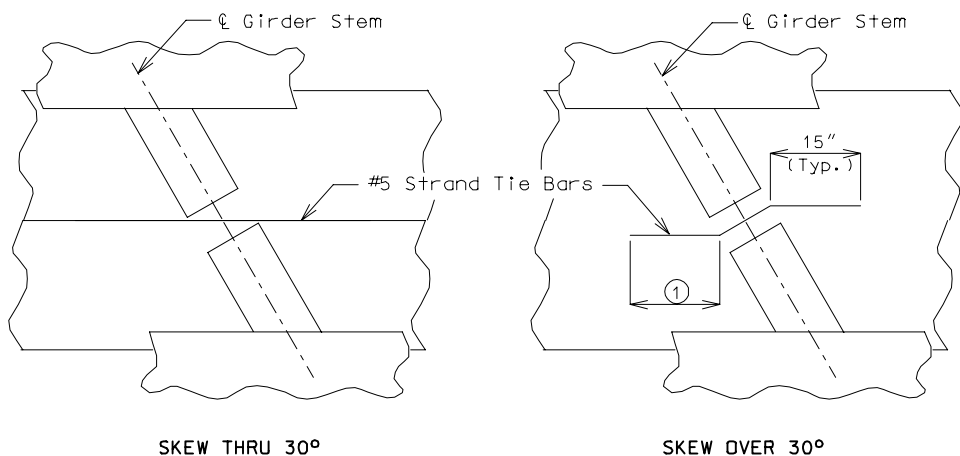
1 1/2"

2" (Min.) (Only necessary to check for curved structures on large skews.)

₵ Two 1 1/4" Ø Holes

4"

End of Top Flange

₵ Girder Stem 4'-0"

PART PLAN OF P/S CONC. DBL. TEE GIRDER

3/4" R 1/8"

DETAIL "A"

Detail "A"

8'-0" (Max.)

9 3/4"

2'-0" (Max.)

Detail "A"

2 1/2"

" Fillet or " Radius typ.)

₵ Girder Stem 4'-0"

16" (Type 16)

22" (Type 22)

30" (Type 30)

7 3/4" (Type 16)

7" (Type 22)

6" (Type 30)

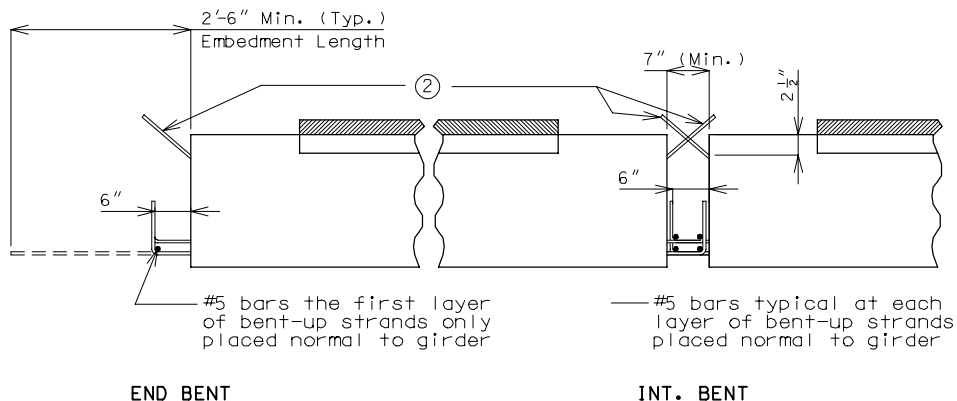SECTION THRU P/S CONC. DBL. TEE GIRDER

2.2 VENT HOLES

Note: Use vent holes only on all stream crossing structures.

℄ 3″ Ø Vent Hole at or
near upgrade 1/3 point
of Double-Tee Girder

7″±

PART ELEVATION OF GIRDER STEM

PART SECTION NEAR
VENT HOLE

2.3   DIAPHRAGM REINFORCEMENT

2'-6" Min. (Typ.) Embedment Length

7" (Min.)

2½"

6"

6"

#5 bars the first layer of bent-up strands only placed normal to girder

#5 bars typical at each layer of bent-up strands placed normal to girder

END BENT   INT. BENT

ℂ Girder Stem

ℂ Girder Stem

#5 Strand Tie Bars

15" (Typ.)

SKEW THRU 30°   SKEW OVER 30°
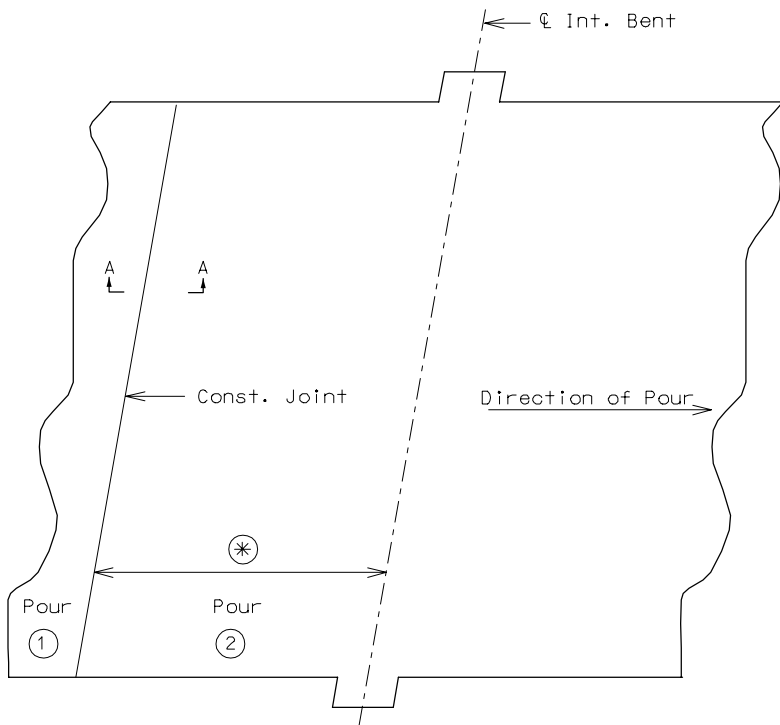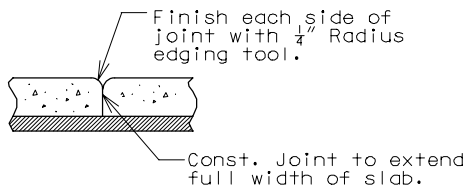
① Omit leg on outside of exterior girder.

② Cut top two rows of strands with 12" projection and bend in shop.

2.4 DETAIL OF OPTIONAL CONSTRUCTION JOINT

℄ Int. Bent

A   A

Const. Joint   Direction of Pour

✳

Pour   Pour

①   ②

OPTIONAL CONST. JOINT

Finish each side of
joint with $\frac{1}{4}$" Radius
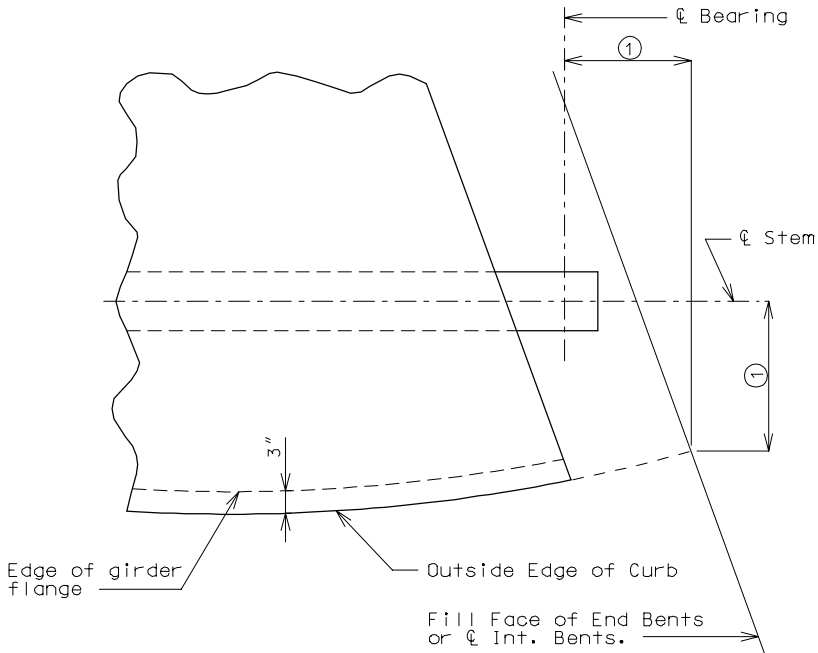edging tool.

Const. Joint to extend
full width of slab.

SECTION A-A

✳   Place Const. Joint 6" from negative reinforcement
in slab.

Note: Const. Joint placement will be determined by direction
of slab pour.

2.5   DETAILS FOR CURVED STRUCTURES

① Show dimension on plans.